

MODEL ANSWERS

Name: _____

ID Number: _____

Time: 2 hours

1 H 1.008																	2 He 4.003
3 Li 6.941	4 Be 9.012											5 B 10.81	6 C 12.01	7 N 14.01	8 O 16.00	9 F 19.00	10 Ne 20.18
11 Na 22.99	12 Mg 24.31											13 Al 26.98	14 Si 28.09	15 P 30.97	16 S 32.07	17 Cl 35.45	18 Ar 39.95
19 K 39.10	20 Ca 40.08	21 Sc 44.96	22 Ti 47.88	23 V 50.94	24 Cr 52.00	25 Mn 54.94	26 Fe 55.85	27 Co 58.93	28 Ni 58.69	29 Cu 63.55	30 Zn 65.38	31 Ga 69.72	32 Ge 72.59	33 As 74.92	34 Se 78.96	35 Br 79.90	36 Kr 83.80
37 Rb 85.47	38 Sr 87.62	39 Y 88.91	40 Zr 91.22	41 Nb 92.91	42 Mo 95.94	43 Tc (98)	44 Ru 101.1	45 Rh 102.9	46 Pd 106.4	47 Ag 107.9	48 Cd 112.4	49 In 114.8	50 Sn 118.7	51 Sb 121.8	52 Te 127.6	53 I 126.9	54 Xe 131.3
55 Cs 132.9	56 Ba 137.3	57 La* 138.9	72 Hf 178.5	73 Ta 180.9	74 W 183.9	75 Re 186.2	76 Os 190.2	77 Ir 192.2	78 Pt 195.1	79 Au 197.0	80 Hg 200.6	81 Tl 204.4	82 Pb 207.2	83 Bi 209.0	84 Po (209)	85 At (210)	86 Rn (222)
87 Fr (223)	88 Ra 226	89 Ac† (227)															

QUESTION	SCORE	MAXIMUM MARKS
1		
2		
TOTAL		

QUESTION 1

(a) Read the following passage about water and answer the questions that follow.

Water

Water is the most abundant compound on earth and covers about 70% of the earth's surface. It is a polar solvent that has an angular structure and dissolves both ionic compounds and polar covalent compounds. Therefore, it is a vitally important solvent in living systems. At room temperature, water is a colourless liquid. Water molecules are strongly attracted to one another by a chemical force called intermolecular hydrogen bonding. At sea level, water boils at 100°C. The density of water at room temperature is 0.99708 g/cm³. Water is a very weak conductor of electricity. In the process of electrolysis, water splits into hydrogen gas and oxygen gas.

(i) List all the **physical properties** of water mentioned in the passage above.
(*You will lose marks for including wrong information*).

Physical properties: properties that are observed or measured without changing the identity of the substance:

Polar solvent

Angular structure

Dissolves both ionic and polar covalent compounds

Colourless

Liquid

Exhibits intermolecular hydrogen bonding

Boiling point of water is 100°C at sea level

Density of water is 0.99708 g/cm³

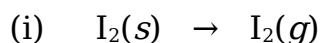
Weak conductor of electricity

(ii) List all the **chemical properties** of water mentioned in the passage above.
(*You will lose marks for including wrong information*).

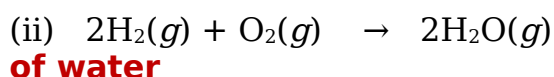
Chemical properties: properties that are observed or measured with a change in the identity of the substance:

Electrolysis of water: water is split with electricity into hydrogen gas and oxygen gas

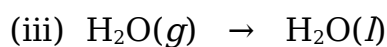
(b) Give the **name** of each of the processes represented by the following equations.



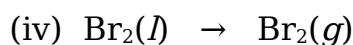
Sublimation of iodine



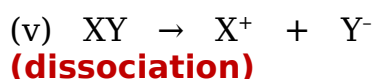
Chemical reaction: formation



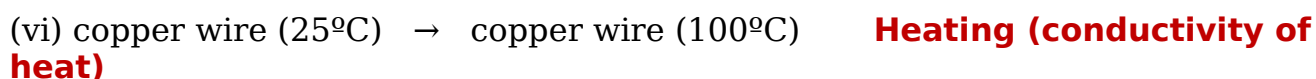
Condensation



Vaporisation (Evaporation)

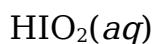


Heterolytic bond cleavage



Heating (conductivity of

(b) Write the **name** of each of the following substances:



Iodous acid



Manganese(II) chromate



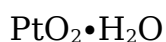
Tetraphosphorus trisulfide



Calcium hydride



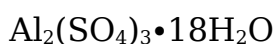
Bismuth(III) hypobromite



Platinum(IV) oxide monohydrate



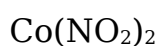
Titanium(III) phosphide



Aluminium sulfate octadecahydrate



Rubidium superoxide



Cobalt(II) nitrite

(d) Write a formula for each of the following substances:

Ammonium lactate
NH₄C₃H₅O₃

CH₃CH(OH)COONH₄ or

Hydrogen peroxide

H₂O₂

Iron(III) nitrate nonahydrate

Fe(NO₃)₃·9H₂O

Scandium(III) thiocyanate

Sc(SCN)₃

Formic acid

HCOOH

Potassium permanganate

KMnO₄

Dinitrogen pentoxide

N₂O₅

Mercury(II) carbide

Hg₂C

Aluminium hydrogen carbonate

Al(HCO₃)₃

Tin(IV) perchlorate

Sn(ClO₄)₄

(d) State whether each of the following is **CORRECT** or **WRONG**. Then **say** what the **mistake or error** is. An example is given.

		CORRECT or WRONG	What is the mistake?
Mg	Manganese	WRONG	The name of the element is wrong
Water	H ₂ O	CORRECT	-
SrS	Strontium sulfide	CORRECT	-
Pd(IO) ₂	Palladium(II) hypoiodide	WRONG	The suffix of the name of the anion is wrong
Cd ²⁺	Cadmium ion	CORRECT	-
F ⁻	Flouride ion	WRONG	The spelling is wrong
Cu ₂ Se	Copper(II) selenide	WRONG	The charge of the copper atom is wrong
NH ₄ CH ₃ COO	Ammonium acetate	WRONG	The chemical formula is written wrongly with the cation not attached to the carboxylate ion
			The physical state is not

HCN	Hydrocyanic acid	WRONG	indicated in the chemical formula
Hg ₂ Cl ₂	Mercury(I) chloride	WRONG	The symbol of the chloride ion is wrong

(e) Complete the following statements:

- (i) A substance that is attracted to a **magnetic field** contains unpaired electrons and is described as **paramagnetic**
- (ii) The maximum number of unpaired electrons in any subshell is **$2l + 1$**
- (iii) The symbol of the element in Period 4 that has the largest number of unpaired electrons in the ground state is **Cr**
- (iv) An example of a metallic polyatomic cation is **Hg₂²⁺**
- (v) An example of a nonmetallic cation is **NH₄⁺**
- (vi) The **three classes** of the elements of life (elements in the human body) according to amounts are **major elements**, **major minerals** and **trace elements**
- (vii) The deficiency of iron in humans causes the disease called **anemia** (or **anaemia**).
- Two examples of proteins in humans that bind iron are **hemoglobin** (**haemoglobin**) and **myoglobin**
- (viii) The sizes and **metallic** character of elements increase on going down a group.
- (ix) The monatomic ions of hydrogen are **H⁺ (proton)** and **H⁻ (hydride ion)**
- (x) According to the Bohr model, the electron of the hydrogen atom is in a circular **orbit**

at a distance of **52.92 pm** away from the **nucleus**.

However, in the **quantum mechanical** model that uses the

Schrödinger equation, a graph of the **radial probability**

distribution *versus* the radius of the 1s atomic orbital shows that the **most probable**

distance at which the electron is located away from the nucleus is **52.92 pm**.

(xi) Atomic orbitals in the same subshell have exactly equal **energy** and are, therefore, described as **degenerate**.

A node is **a region in an atom that has zero probability of finding an electron**

(xii) When an atom ionizes, the electron goes to the energy level **$n = \infty$**

(xiii) The electron configuration of the silver ion is:



(xiv) When oleic acid is deprotonated, the ion formed is called **oleate ion**

(xv) The names of the two elements whose deficiency causes bone weakness are:

Calcium and **phosphorus**

(xvi) Metals are classified as main-group or **transition**

(xvii) Tellurium is classified as a **metalloid** and a **chalcogen**

(xix) Metals **lose** electrons when they form ionic compounds; therefore they are said to be **reducing** agents.

(xx) Hund's rule states that the lowest energy **electron configuration** for an atom

is the one **with the maximum number of unpaired electrons** in a particular

set of **degenerate** orbitals.

(xxi) The types of covalent bonds are **nonpolar covalent** and **polar covalent**.

These are distinguished by the **electronegativity difference**

between the atoms bonded together. On the other hand, covalent bonds can be classified as

triple, double and **single** according to their **bond order**.

Double and triple bonds are together known as **multiple bonds**.

In such bonds (double and triple), the overlap of orbitals results in two types of chemical bonding,

namely **σ -bonding** and **π -bonding**.

The length of a covalent bond is defined as **the internuclear distance between the atoms**

covalently bonded together

The bond length of Br₂ is 228.4 pm and that of BrCl is 213.8 pm. Thus we estimate the

bond length of Cl₂ to be **199.2 pm**.

From the Lewis structures of **ozone**, **peroxide ion** and **molecular oxygen**, we can arrange the

bond lengths of these substances as follows:

peroxide ion > ozone > molecular oxygen

QUESTION 2

(a) Draw the Lewis dot symbol of the following:

(i) Selenium

(ii) The aluminium ion.

(b) **Draw** the **molecular shapes** of the following substances and **name** them. Assign **polarity**.

Dinitrogen monoxide (N is the central atom)



(c) **Discuss** fully the structure of the **acetate ion**.